Run-8 Trigger/DCM Rates and Projections (d-Au @ 200 GeV)

Jamie Nagle, University of Colorado
November 2, 2007

Table 2: Maximum luminosities that can be reached after a sufficiently long running period. All numbers are given for operation at an energy of 100 GeV/nucleon.

Mode	No of bunches	Ions/bunch $[10^9]$	β^* [m]	Emittance [μm]	$\mathcal{L}_{peak}$ $[cm^{-2}s^{-1}]$	$\mathcal{L}_{store\ avg}$ $[cm^{-2}s^{-1}]$	L_{week}
Au-Au	103	1.1	0.85	17-35	30×10^{26}	12×10^{26}	350 μb^{-1}
Cu-Cu	111	6	0.9	15-30	12×10^{28}	4×10^{28}	14 nb^{-1}
Si-Si	111	12.5	0.9	15-30	50×10^{28}	17×10^{28}	60 nb^{-1}
d-Au	83	120d/1.1Au	1.0	15-30	30×10^{28}	14×10^{28}	40 nb^{-1}
p↑-p↑ *	111	175	0.9	20-25	70×10^{30}	40×10^{30}	14 pb^{-1}

*We expect that an average store polarization of 65% can be reached. If both STAR and PHENIX elect again to have 9 non-colliding bunches, the luminosity is reduced by 9% compared to the numbers stated in the table.

Assume 2.26 barn d-Au inelastic cross section, BBCLL1 firing on 88%, and |zvtx| < 30 cm on 50%....

→ Peak = 300 kHz   → Average = 140 kHz

Plan trigger and DAQ throughput based on maximum peak rate.

CAD Guidance from Wolfram Fischer….

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the projections for the upcoming d-Au run are not as reliable as
the projections for the previous Au-Au run. We have not
been running d-Au since 2003, and expect an order of
magnitude increase in delivered luminosity compared to Run-3.
For Run-7 we had only about a factor 2 increase in delivered
luminosity compared to Run-4, the last time we ran Au-Au.

The best guidance is probably obtained by looking at Run-3 (d-Au),
the proton lifetime in Run-6 (for d guidance), and the Au lifetime
in Run-7 (for Au guidance).

We have the following average fit parameters for a double
exponential luminosity decay:
Run-3 (d-Au)
30% fast exp. decay with t=1.1h, slow decay with t=4.7h.
Run-6 (pp)
10% fast exp. decay with t=0.3h,  slow decay with t=12h
Run-7 (Au-Au)
30% fast exp. decay with t=0.5h, slow decay with t=5h (incl. stochastic cooling in Yellow)

One could reasonably assume for
Run-8 (d-Au)
20% fast exp. decay with t=0.4h, slow decay with t=8-10h.
(I would weigh the Run-6 and Run-7 experience more than Run-3.)

This gives an optimum store length of about 6-7 hours, assuming 2h turn-around
time and 0.2h detector turn-on time.

As I said before, this is far off from where we have been running, and
therefore has a larger error than last year.

Regards,

Wolfram
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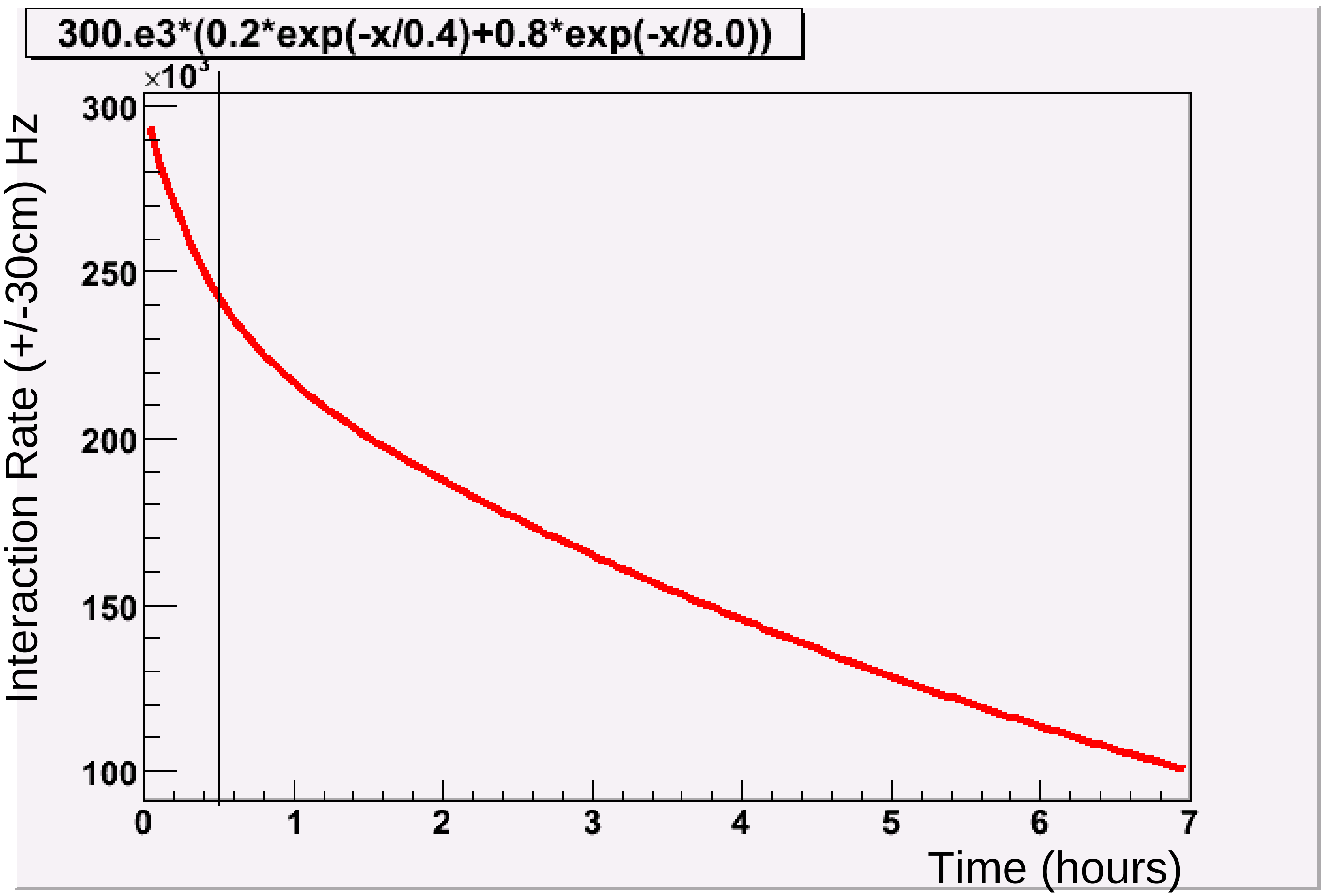
Plugging in Wolfram's numbers and 300 kHz at the start (peak), one gets the following luminosity profile. The average rate over a 7 hour store is 160 kHz.

Note that after the first 30 minutes (which often includes cogging, steering, collimating, getting the PHENIX DAQ running), the luminosity drops before 250 kHz.



DAQ Throughput (DCM Perspective)

For d-Au sized events, we believe the DCM's can push 7 kHz through to the EvB.

Key issues FCAL, HBD, noisy DC channels…

- Note that the FCAL was not run last year. If zero suppression / occupancy are issues, this could be a rate limiter.

- HBD – at last year's noise level it could be a rate issue in d-Au. Most likely not part of the main readout during most of this run.

- DC has some noisy FEEs that are near the limit. Also, there is a remaining concern about DC FEE issue at higher rates (multi-event buffering)

- Need to pay careful attention to RXPN, MPC etc. in terms of zero suppression and/or total volume per fiber.

Matt Wysocki and I have a new DCM code that has a DMA transfer in parallel with the DMA input and processing the next bank. Not yet tested. This could yield some possible speed improvements ? Priority to test?

d-Au Trigger Rejections

Assume rejection is related to collision particles and scale down from proton-proton rejections by d-Au <nbinary>=7.6 as a crude first pass rejection (more reliable than using Run 3 d-Au values – many reasons).

There are very rough and need immediate checking with stable beam.

Trigger	Rej. in P+P	Projected Rej. d-Au	Rate at 300 kHz
MUID1D1S (North)	14,000	1800	160 Hz
MUID1D1S (South)	23,000	3000	100 Hz
ERT4x4c (~1.5GeV)	75	9	30,000 Hz
ERT4x4a (~2.1GeV)	926	121	2,400 Hz
ERT4x4b (~2.9GeV)	3100	400	750 Hz
ERT_E (600 MeV)	500	65	4,600 Hz
MUID1D (North)	670	88	3,400 Hz
MUID1D (South)	950	125	2,400 Hz

Proposed Trigger Plan

Use pp Rejections / dAu <nbinary> = 7.6

Assume up to 7 kHz bandwidth through DAQ (ignores trigger correlations)

				BBCLL1			BBCLL1	
				300000			250000	
	Trigger	Rejection	Raw	Prescale	Rate	Raw	Prescale	Rate
0	MUIDLL1_N2D || S2D	1.0	300000	9999999	0	250000	9999999	0
1	Clock		10000000	999999	10	10000000	999999	10
2	BBCLL1	1.0	300000	600	499	250000	500	499
3	BBCLL1 (noVertexCut)	0.5	600000	10000	60	500000	5000	100
4	ZDCLL1Wide	25.0	12000	200	60	10000	100	99
5	ZDCLL1Narrow	10.0	30000	1000	30	25000	2500	10
6	Open	99999999.0	0	160	0	0	160	0
7	ERTLL1_4x4a	1.4	207273	9999999	0	172727	9999999	0
8	ERTLL1_2x2 & BBCLL1	6.6	45600	9999999	0	38000	9999999	0
9	ERTLL1_4x4a & BBCLL1 [~2.1 GeV]	121.8	2462	0	2462	2052	0	2052
10	ERTLL1_4x4c [1.4 GeV]	99999999.0	0	600	0	0	600	0
11	ERTLL1_4x4b & BBCLL1 [~2.8 GeV]	407.9	735	0	735	613	0	613
12	ERTLL1_4x4c & BBCLL1 [~1.4 GeV]	9.9	30400	50	596	25333	40	618
13	ERTLL1_Electron & BBCLL1 [~600 MeV]	65.8	4560	0	4560	3800	0	3800
14	MUID_LL1_N_1Deep & BBCLL1	52.6	5700	10	518	4750	16	279
15	MUID_LL1_S_1Deep & BBCLL1	52.6	5700	10	518	4750	16	279
16	MUID_LL1_N_1Shallow & BBCLL1	7.9	38000	200	189	31667	90	348
17	MUID_LL1_S_1Shallow & BBCLL1	7.9	38000	200	189	31667	90	348
18	MUID_LL1_N_1D1S & BBCLL1	1842.1	163	0	163	136	0	136
19	MUID_LL1_S_1D1S & BBCLL1	3026.3	99	0	99	83	0	83
20	MuID_LL1_N_1D & S_1D & BBCLL1	15000.0	20	0	20	17	0	17
21	(MUIDLL1_N2D || S2D) & BBCLL1	2631.6	114	0	114	95	0	95
22	Open	99999999.0						
23	ZDCN||ZDCS	1.3	230769	1923	120	192308	1923	100
24	ZDCNS			1000			500	
25	MPC 4x4a	99999999.0	0	0	0	0	0	0
26	MPC 4x4b	99999999.0	0	0	0	0	0	0
27	ERTLL1_4x4b	99999999.0	0	0	0	0	0	0
28	PPG(Pedestal)			0	1		0	1
29	PPG(Test Pulse)			0	1		0	1
30	PPG(Laser)			0	1		0	1
31	Noise	OFF			0			0
					10946			9488

500 Hz Minimum Bias BBCLL1 with 1 PMT on each side. Need to watch background issue.

γ, π0 is okay with highest threshold.

J/ψ → ee (threshold 600 MeV for ERT-e). Then check rejection carefully.

J/ψ → μμ is fine.

Physics Issues for PWGs to think about….

1. Proposal is to start with ERT 2x2 threshold = 600 MeV. This safely keeps the J/$\psi \rightarrow$ee up to 200 kHz and is close to keeping all at 300 kHz.

If the luminosity turned out to be much lower, we could consider a lower threshold. If the rejection is somewhat worse, we might consider raising the threshold to 800 MeV.

2. Single muons definitely need a large prescale. What is the physics priority of single deep or single shallow (e.g. for identified stopped hadrons) in this run?

3. We will need to check all rejections early in the run since the current estimates are rough (x2-5?) – not including new background sources.

4. We need a proposal for MPC triggers and then check rejections.

5. The 7 kHz Level-1 accept rate is contingent on careful checking of noisy channels, good zero suppression, and DAQ work.

6. John Lajoie will make preliminary trigger setup files.

Date: Thu, 18 Oct 2007 11:08:57 -0400
From: Kensuke Okada <okada@bnl.gov>
To: jamie.nagle@colorado.edu
Cc: john lajoie <lajoie@iastate.edu>, okada@bnl.gov
Subject: Re: Run-8 ERT trigger
Parts/Attachments:

1	Shown	97 lines	Text
2	OK	268 KB	Image

Dear Jamie,

1. ERT2x2 in Run6pp 200GeV
   The attached file (Run6pp_electron.gif) shows the rejection of ERT-electron.
   Run188000-Run200000 (DAC=24, ~0.4GeV/tile) RF~120
   Run200000-Run205000 (DAC=29, ~0.6GeV/tile) RF~500
   The step at around Run202500 is when we removed the BBCLL1 requirement. (see #2993 Run6log)

   We didn't have 0.8GeV/tile setting.

2. hot tower map
   Look at the Run6ERT summary
   https://www.phenix.bnl.gov/WWW/p/draft/okada/060711/Run6ERTmemo.pdf
   Page 5 shows a typical hit occupancy monitor. The green bar means masks.
   The PbGl in 4x4c has a lot of masks, but it is because PbGl has lower energy threshold and we r
power to be more than 100. (The problem was the difference between PbGl and PbSc threshold. We ca
coarse DAC setting.)